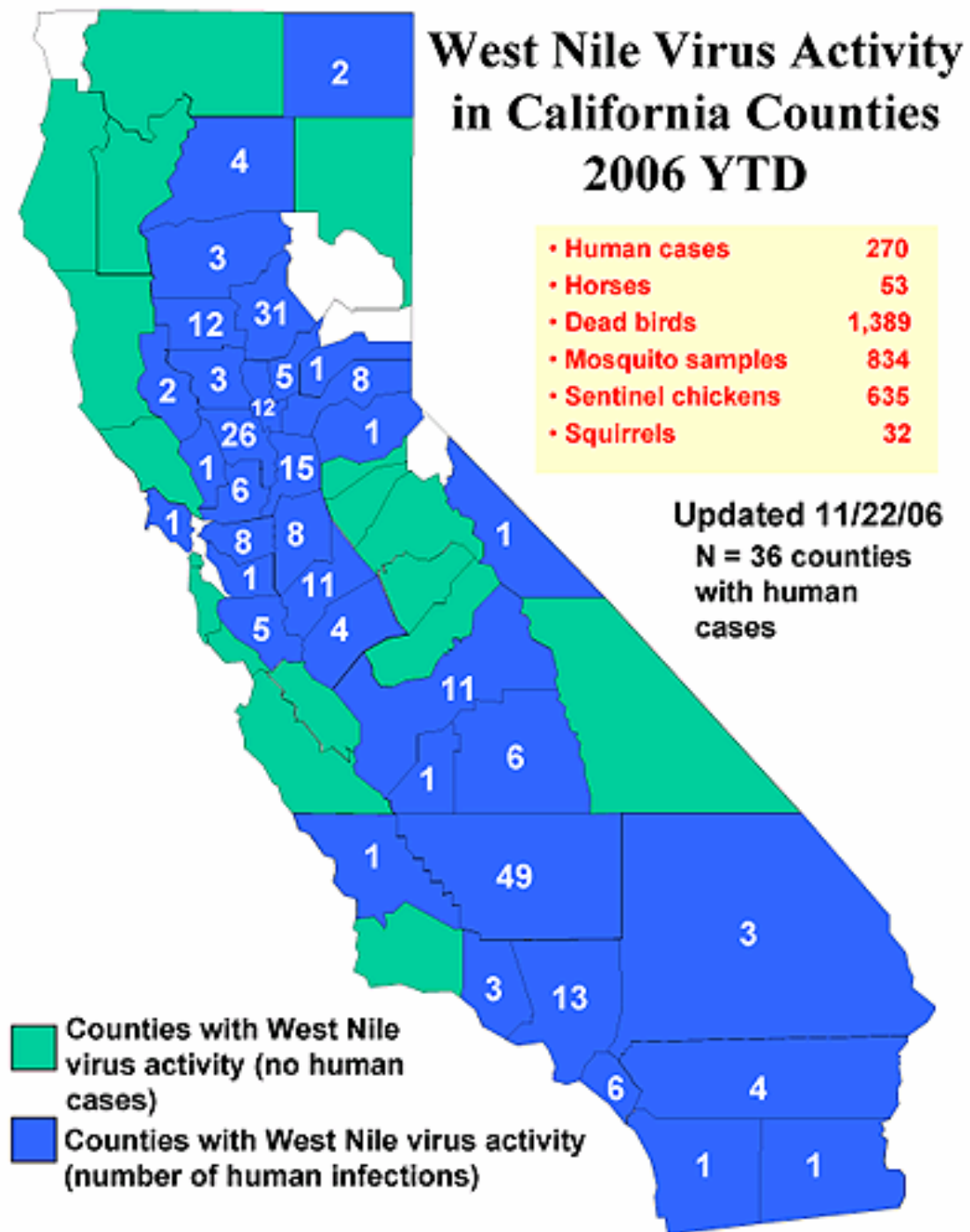
The background of the slide is a close-up, grayscale image of a mosquito, showing its legs, wings, and body in detail.

# West Nile Virus and Human Disease: Severity of Illness and Risk Factors

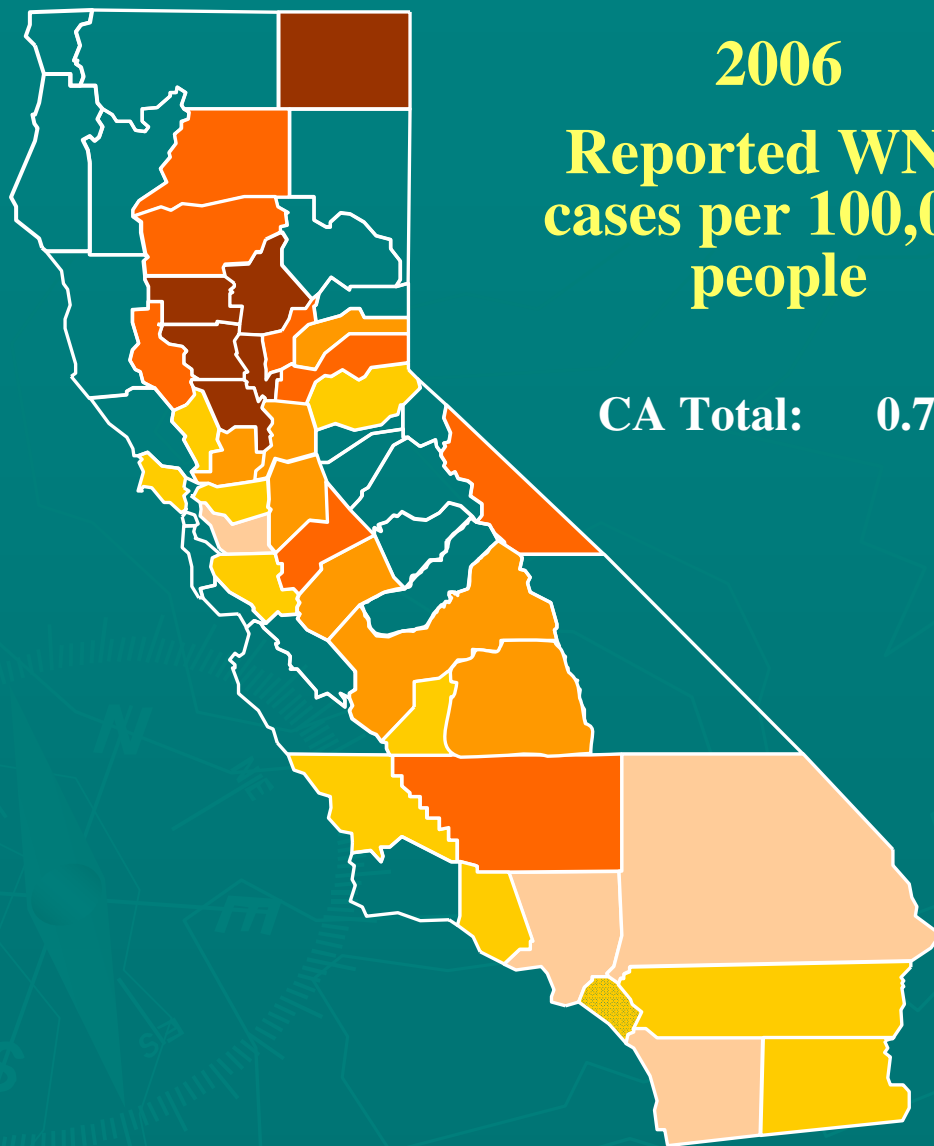
**Anne Kjemtrup, DVM, MPVM, Ph.D.**  
**California Department of Health Services**  
**Vector-Borne Disease Section**

# WNV Infections California 2006



# 2006 Reported WNV cases per 100,000 people

CA Total: 0.79



Glenn	45.4
Modoc	21.17
Butte	16.7
Colusa	15.9
Yolo	15.4
Sutter	15.2

≥15



Yuba	11.6
Mono	7.8
Kern	7.7
Tehama	5.5
Lake	3.4
Placer	3.2
Stanislaus	2.7
Shasta	2.5

≥2



Merced	1.9
Tulare	1.6
Solano	1.5
Fresno	1.5
San Joaquin	1.4
Sacramento	1.3
Nevada	1.1

≥1



Contra Costa	0.8
Napa	0.8
Kings	0.8
Imperial	0.7
El Dorado	0.6
S.L. Obispo	0.4
Marin	0.4
Ventura	0.4
Santa Clara	0.3
Riverside	0.3
Orange	0.3

≥ 0.3



Others	
--------	--

> 0

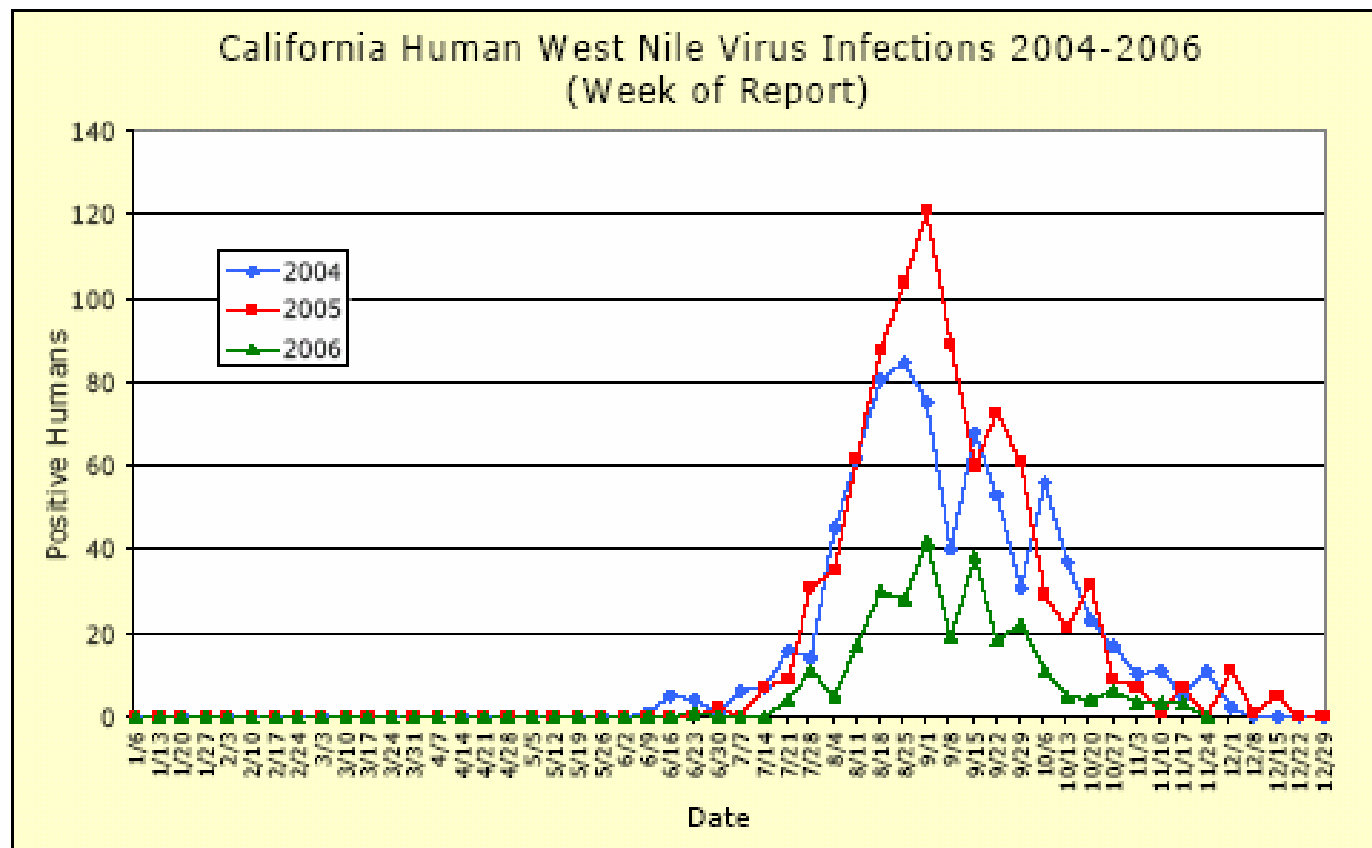


# WNV Cases California 2006

Case presentation	Number	Percent
West Nile fever	184	68%
West Nile neuroinvasive disease	81	30%
Unknown clinical presentation	5	2%

# Occurrence of WNV California 2004 ~ 2006

Comparative Line Graphs of West Nile Virus Activity in 2004, 2005, and 2006  
Updated (11/22/06)



# Update on 2006 Human Studies

- ◆ California Department of Health Services Projects and Collaborations
  - ◆ Studies from the Viral and Rickettsial Disease Laboratories
  - ◆ Update on the West Nile Fever Follow-up study coordinated by the Vector-Borne Disease Section
- ◆ Other WNV Projects and collaborations in California

# Encephalitis Outcome Study

Shilpa Gavali-Jani, VRDL

- ◆ 92 WNV 2004 -2005 encephalitis cases requested to complete activities of daily living questionnaire at 3, 6, 12 months after hospital admission for WNV encephalitis.
  - ◆ 62 (67%) individuals completed at least one survey.
  - ◆ Demographics, clinical and laboratory findings, similar between responders and non-responders except that more females than males responded.

# Encephalitis Outcome Study

- 14/112 (13%) of individuals eligible for follow-up had died.
- Of the 30 non-responders, at least had 1 died.
- By 12 months of follow-up, most people were living at home independently.



# Encephalitis Outcome Study

Many patients reported worsened neuropsychological functioning at 6 or 12 months compared with 3 months

New Problem (Example)	3 month (N=36)	6 month (N=44)	12 month (N=51)
depression	28%	20%	37%
problems finding the right word	25 %	39 %	41 %

# Encephalitis Outcome Study Conclusions

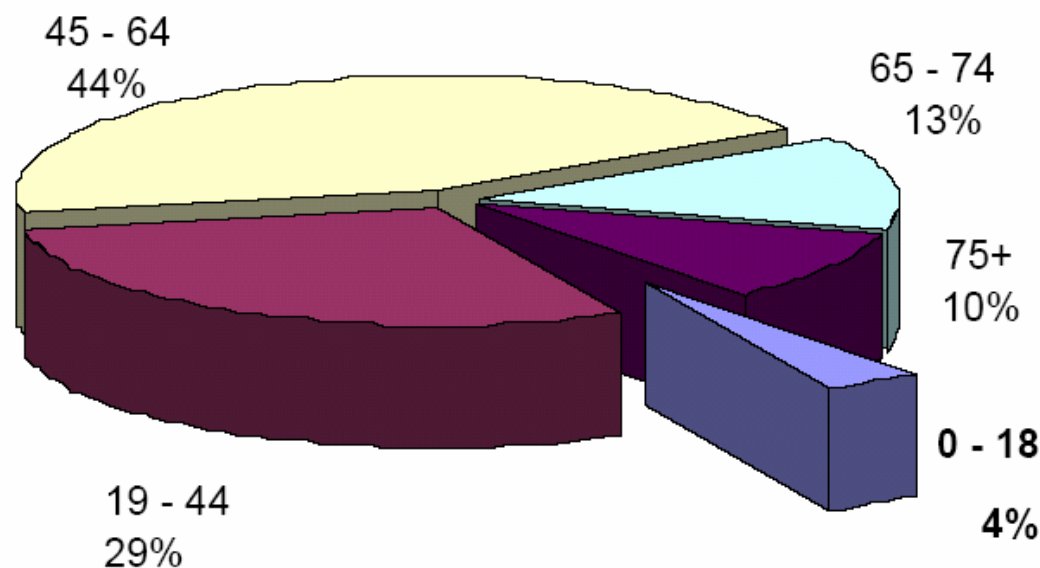
- ◆ **Recovery of neurologic function is maximal during the first 3 months after hospitalization**
- ◆ **Several psychological/social measures worsened over time and conferred significant morbidity in this population**
- ◆ **Findings similar to findings from the Tennessee Unexplained Encephalitis Study's unpublished results**

# California Pediatric WNV Cases: 2004-2005

LJ Christie, SS Gavalí, C Jean, S Honarmand, CA Glaser

**A survey of outcomes was developed and implemented for both WNF and WNND in California pediatric patients from 2004 and 2005.**

Figure 1: 2005 West Nile virus cases, by age



# California Pediatric WNV Cases: 2004-2005

## Results

**Table 1: Pediatric and Adult West Nile Virus Disease by syndrome (2004-2005):**

	Pediatric N=72		Adult N=1584	
	n	(%)	n	(%)
Clinical presentation				
West Nile fever	41	(59)	876	(61)
Meningitis	15	(22)	306	(21)
Encephalitis	10	(10)	200	(14)
Acute flaccid paralysis*	6	(9)	59	(4)
Unknown	3	(4)	143	(9)

\* Acute flaccid paralysis may occur with other clinical presentations

# California Pediatric WNV Cases: 2004-2005

## Results (continued)

- ◆ Significant WNV disease does occur in the pediatric population but less frequently than in adults
- ◆ Pediatric patients with WNV presented with significantly more headache ( $p=0.02$ ) and rash ( $p=0.03$ ) than adults.
- ◆ WNF patients in general do well, returning to baseline functioning within a few weeks to months.
  - ◆ Persistent headaches are a concern in WNF pediatric patients.

# California Pediatric WNV Cases: 2004-2005

## Results (continued)

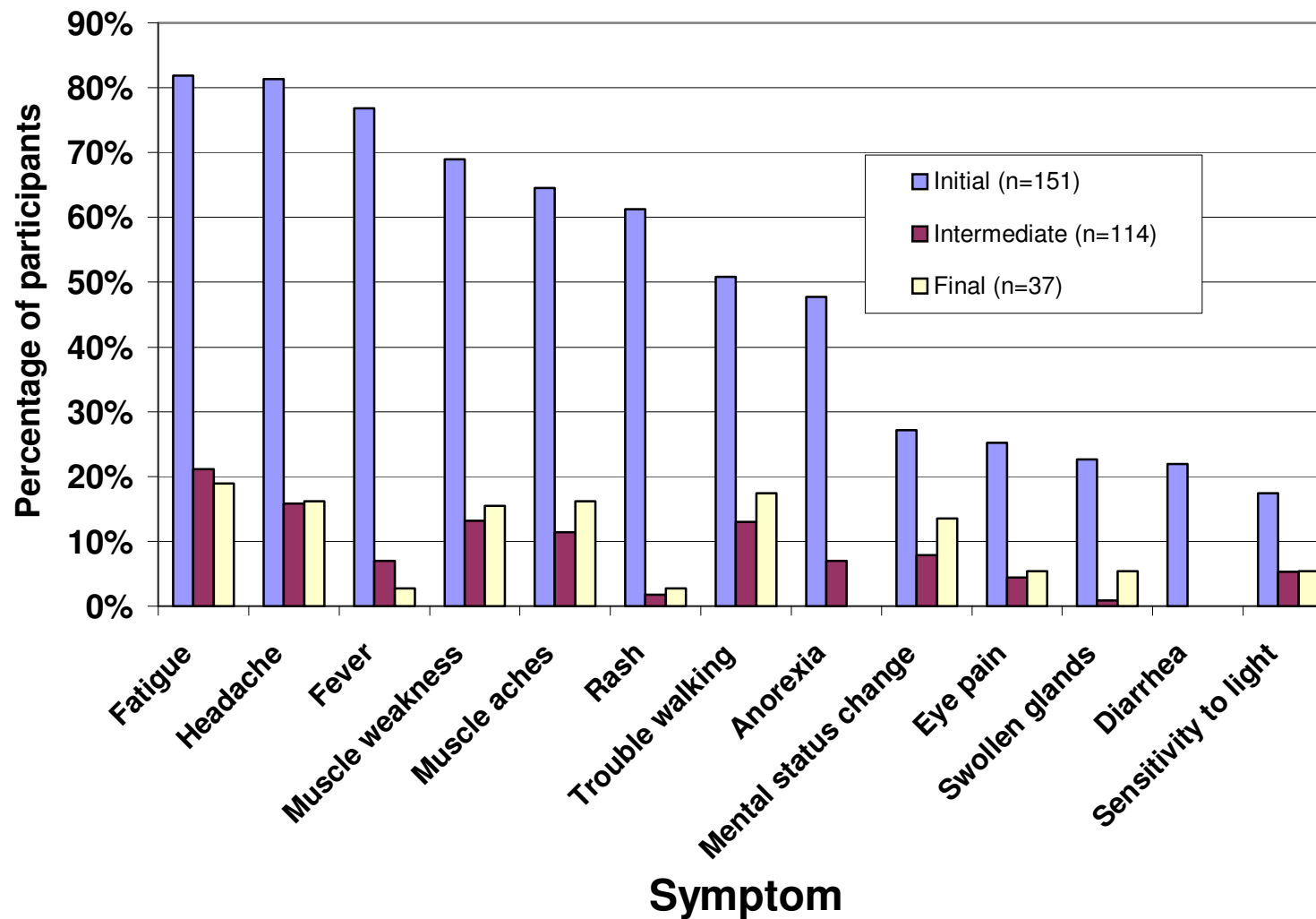
- ◆ WNND pediatric patients typically returned to baseline within a few months.
  - ◆ Psychosocial impairments lasting months in pediatric WNND patients are concerns, especially in encephalitis patients.
- ◆ Recall bias and baseline functioning can affect results.
- ◆ Ongoing surveys are being evaluated for pediatric patients from the 2006 WNV season.

# WNV Fever Follow-up, 2004

A Kjemtrup, J. Riggs-Nagy, C. Jean, C. Glaser, C. Fritz, D. Gillis, D. Vugia

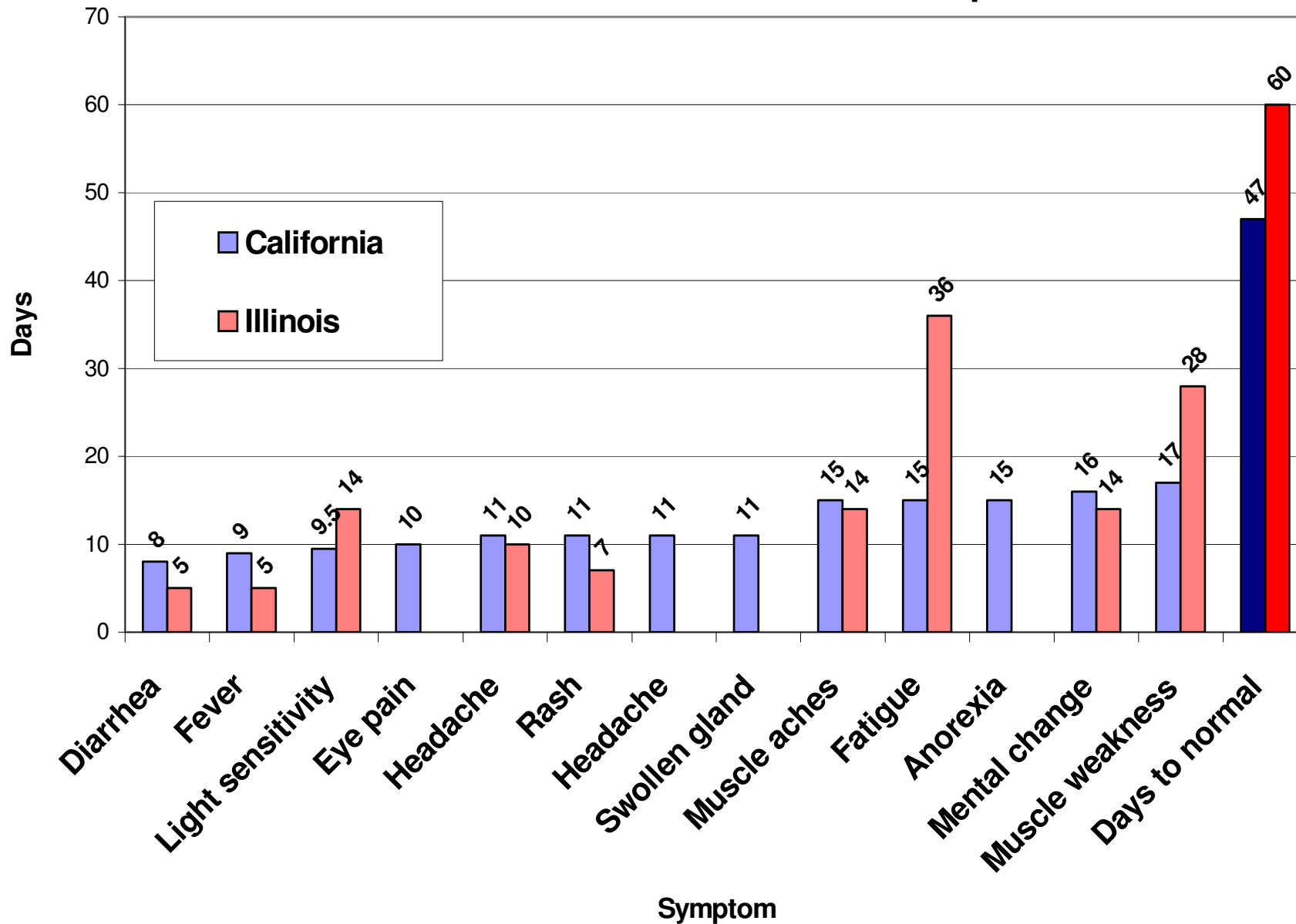
- ◆ **WNV fever case participants contacted within 2, 3 and 9 months of onset.**
  - ◆ Participants were queried about their acute and persistent symptoms.
  - ◆ Once a participant stated they were “100% back to normal” or reported no continuing or new symptoms, follow-up was discontinued
- ◆ **Participating Counties:**
  - ◆ Fresno
  - ◆ Kern
  - ◆ Orange
  - ◆ Riverside
  - ◆ San Bernardino

## 2004 Follow-Up Frequency of Reported Symptoms





## Medium Duration of Symptoms in WNV Patients, California and Illinois\* Studies Compared



\*Watson JT *et al.* Ann Intern Med 2004; 141:360-5

# WNF Outcome Issues to Address

- ◆ How can quality of life issues be addressed more quantitatively?
- ◆ How does recovery from WNV fever compare with recovery from other illnesses with similar initial presentations?
- ◆ How can potential for recall bias be minimized?

# WNF Follow-Up 2005-2006

J. Riggs-Nagy, C. Jean, E. Aquino, A. Kjemtrup

## Case-Control Study

- ◆ Unmatched case-control study
- ◆ **Case:** a person with a fever-like illness who **tested positive for West Nile** and did not have encephalitis, flaccid paralysis, or aseptic meningitis
- ◆ **Control:** a person with a fever-like illness who **tested negative for West Nile** and did not have encephalitis, flaccid paralysis, or aseptic meningitis

Study made possible by helpful participation from local health departments.

# WNF Follow-Up 2005-2006 Methods

## 1 month survey

- Contact, consent and establishment of symptoms at onset obtained

## 2 month and 9 month follow-up surveys

- Quality of life assessment (SF-36)
- Scores can be compared between cases and controls as well as between cases and the general U.S. population

# WNF Follow-Up 2005-2006 Methods

36-item Short-Form General Health Survey (SF-36):  
standardized quality of life assessment tool

- ◆ Used in the 2 and 9 month surveys
- ◆ Measures participants' perceived:
  - ◆ Physical functioning
  - ◆ Physical health
  - ◆ Bodily pain
  - ◆ General health
  - ◆ Vitality
  - ◆ Social functioning
  - ◆ Emotional status
  - ◆ Mental health

# WNF Follow-Up 2005-2006

## Initial Results

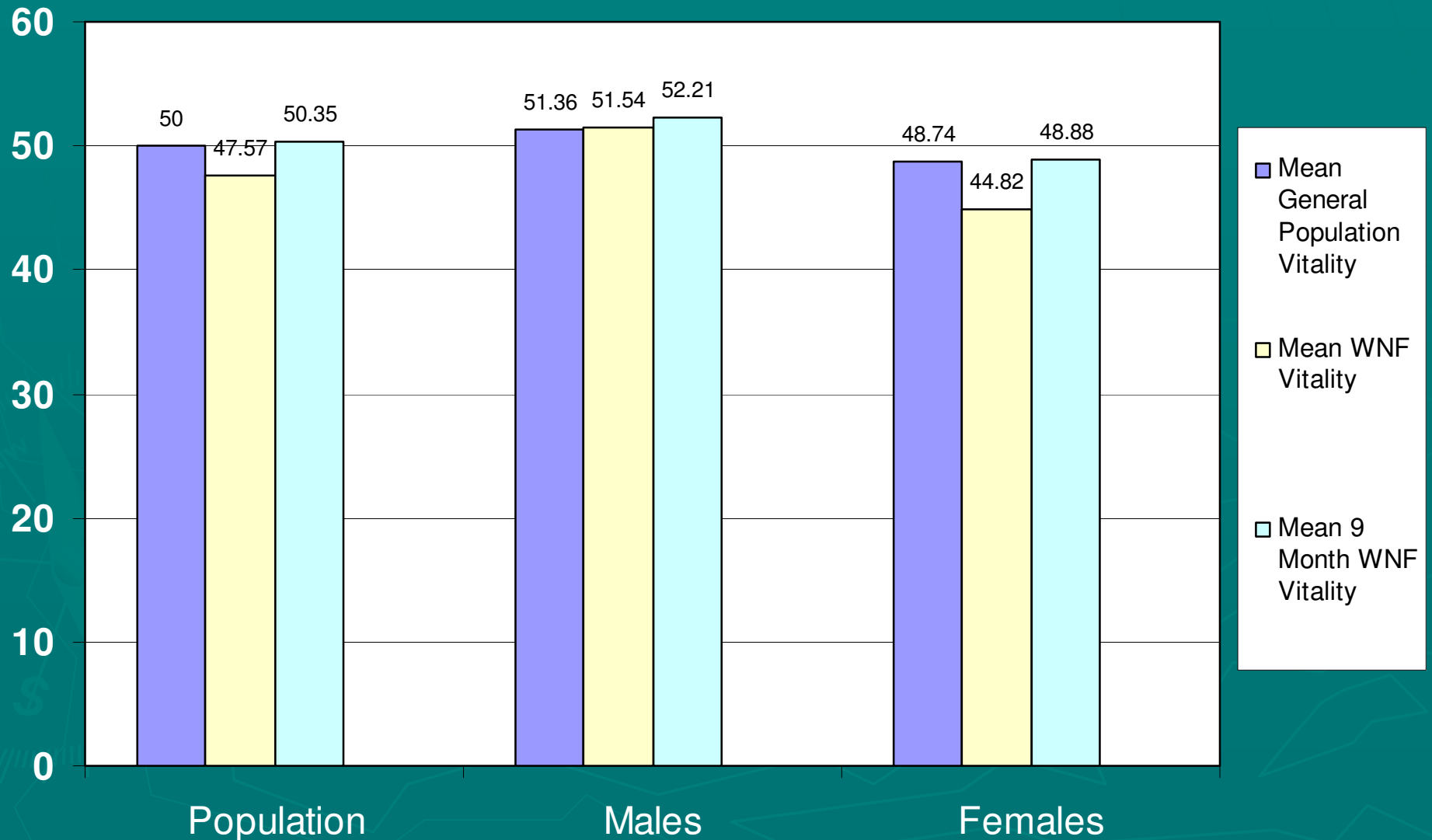
	Interview 1		Interview 2		Interview 3	
	Case	Control	Case	Control	Case	Control
<b>Number of Participants</b>	203	21	140	12	61	0
<b>Age Range (Mean)</b>	18-88 (52)	20-83 (49)	18-88 (53)	20-83 (50)	28-84 (56)	--
<b>% Female</b>	50.1% (5uk*)	55% (1uk)	55% (1uk)	60% (14uk)	56% (2uk)	--

\* uk=unknown status

# WNF Follow-Up 2005-2006 Frequency of Reported Symptoms

	Number (%) of participants reporting	
Symptom	cases n=199 (%)	controls n=18 (%)
Fatigue	172 (86.4)	18 (100)
Headache	156 (78.4)	16 (88.9)
Muscle aches	145 (72.9)	17 (94.4)
Muscle weakness	143 (71.9)	15 (83.3)
Fever	136 (68.3)	15 (83.3)
Rash	101 (50.8)	6 (33.3)
Trouble walking	84 (42.2)	7 (38.9)
Anorexia	115 (57.8)	12 (66.7)
Eye pain	88 (42.2)	8 (44.4)
Swollen glands	45 (22.6)	8 (44.4)
Diarrhea	56 (28.1)	7 (38.9)
Sensitivity to light	83 (41.7)	8 (44.4)
Loss of balance	80 (40.2)	6 (33.3)

# WNF Follow-Up 2005-2006 Vitality (Energy Level) Scores





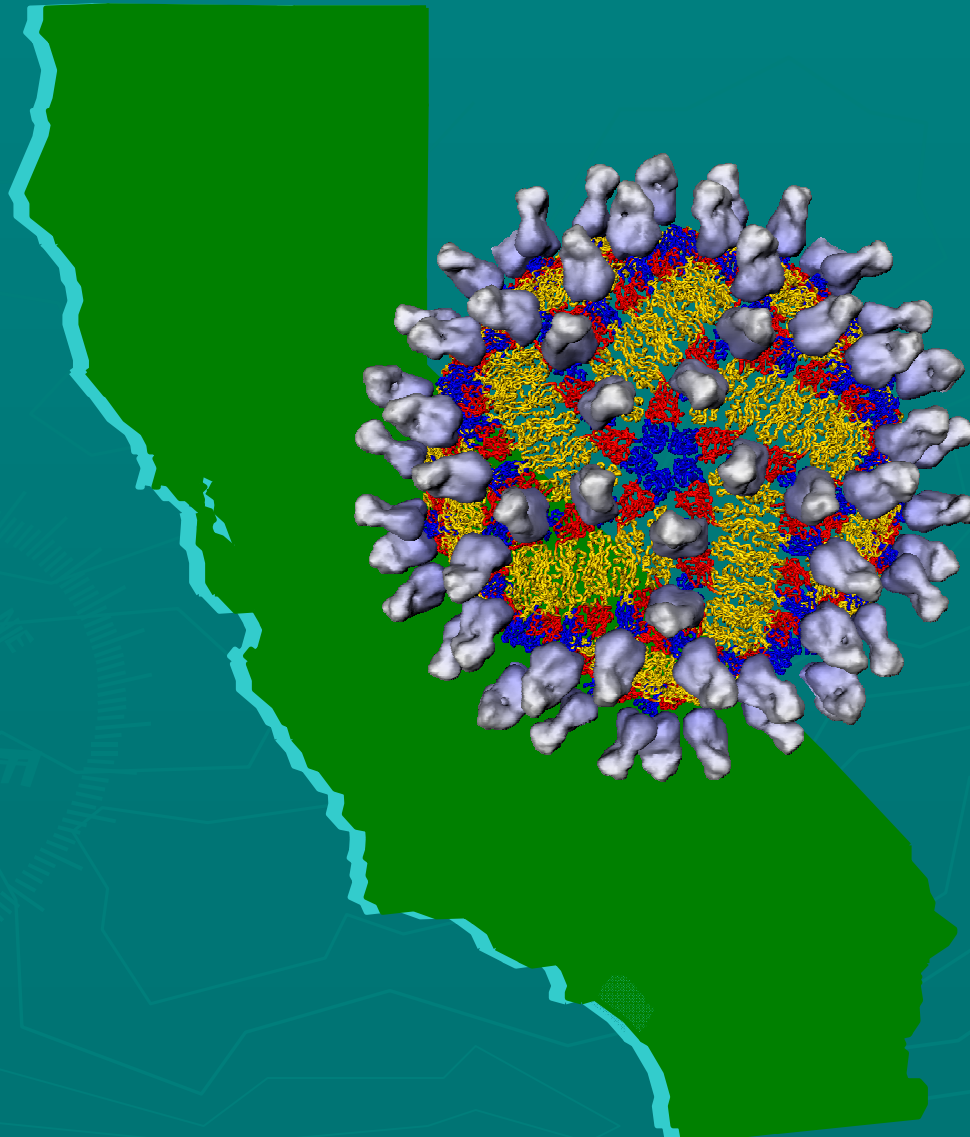
# WNV Follow-Up 2005-2006

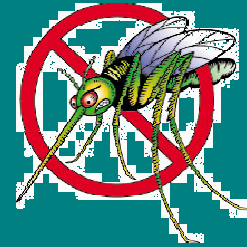
## Thoughts so far....

- ◆ Most WNV Fever patients recover within first few months after illness
- ◆ Continued or new problems may be age and/or sex related
- ◆ Additional data, especially of control patients, will help address how recovery from WNV infection differs from other illnesses

# West Nile Virus

## Other Studies in California





*Aerial Pesticide Spraying for WNV  
Mosquito Control and the Incidence of  
Respiratory Complaints in Sacramento  
County, August 2005*

**Este Geraghty, MD, MS, MPH  
University of California Davis**

# Geraghty Study

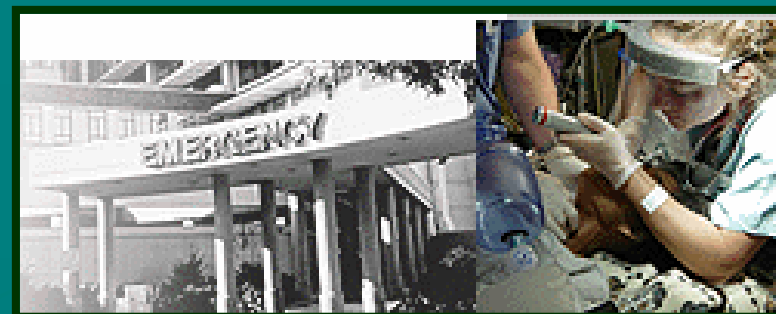
## ◆ Research Question

- ◆ Does aerial spraying with a pyrethrin pesticide for West Nile virus mosquito control increase an individual's risk for a respiratory problem?

## ◆ Hypothesis

- ◆ Aerial spraying does not increase the incidence of respiratory complaints as measured by hospital discharge and emergency room data.

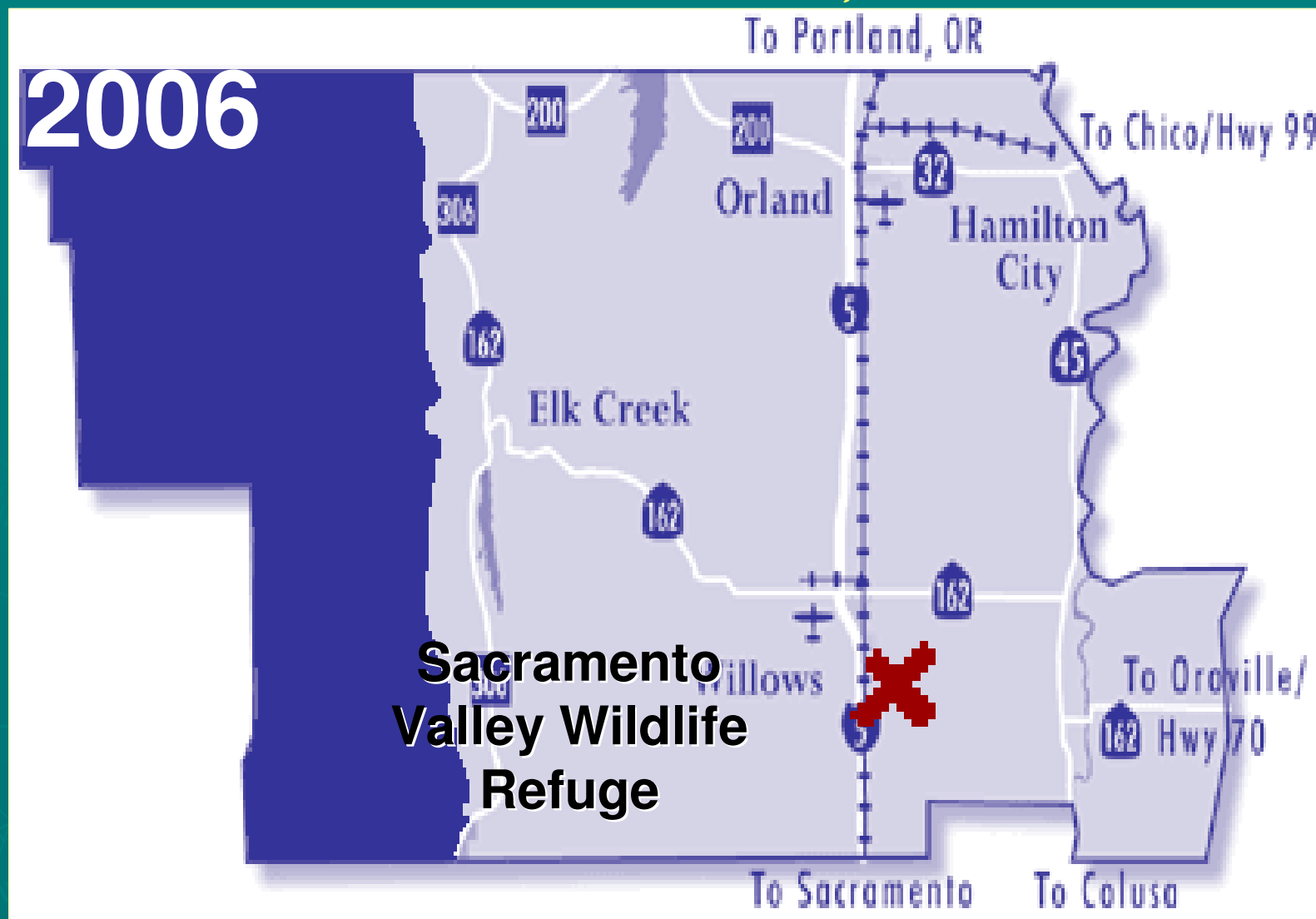
# Geraghty Study : Emergency Room Visits



- ◆ Medical Information Reporting for California (MIRCal), 01/01/05
  - ◆ ED Data
    - ◆ Data elements: DOB, service date, principle diagnosis, zip code, disposition, gender, ethnicity, among others
  - ◆ Hospital Inpatient Discharges
- ◆ Case-crossover design and GIS will be used to evaluate timing of ED-room visits with spray time and location
- ◆ Study underway 2006 -2007

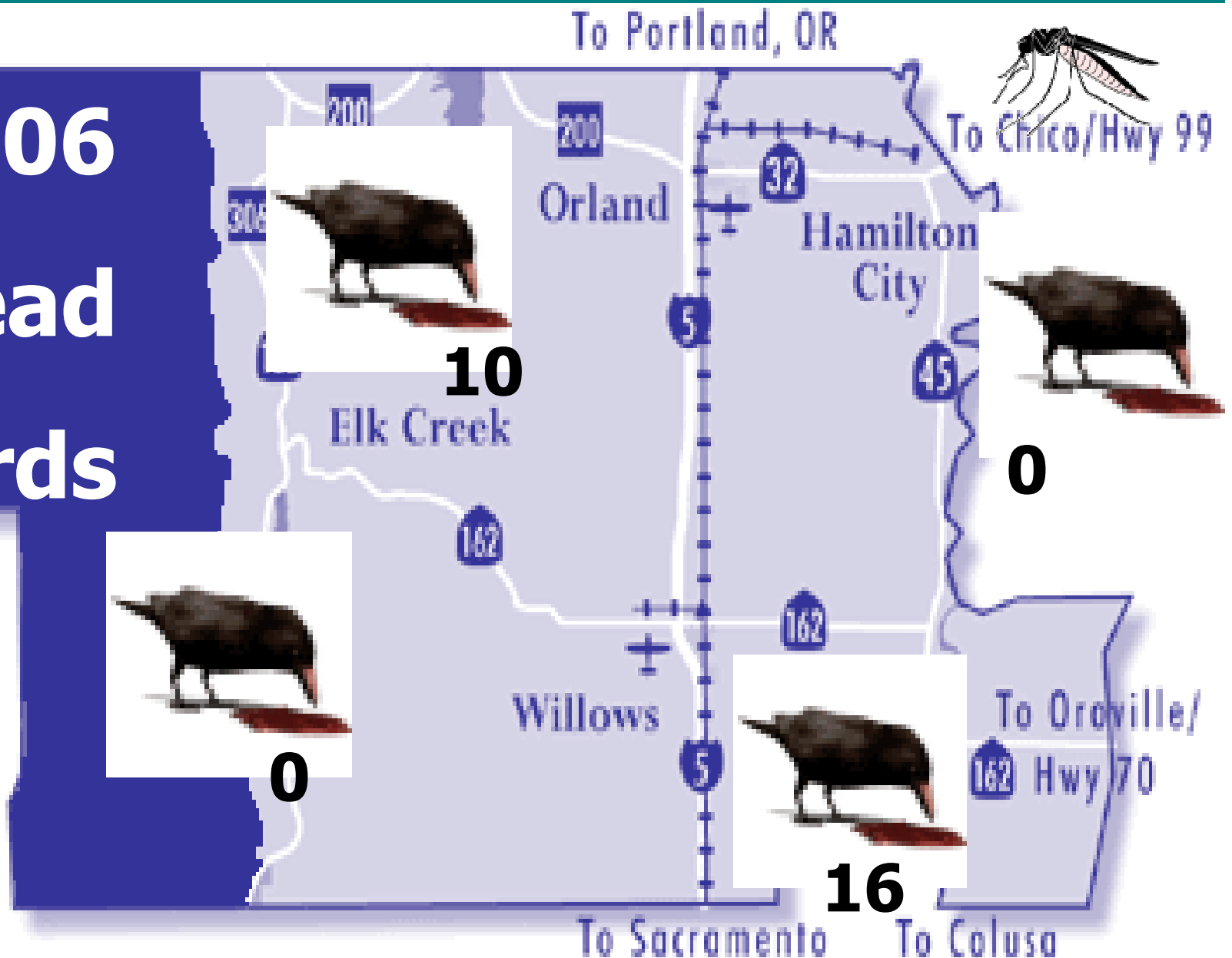
# Glenn County: Nip Boyes

2006



**Positive mosquito pools**

# 2006 Dead Birds



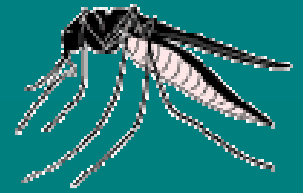
**2006  
Human**

**2 Human  
Cases**





# Glenn County Summary 2004-2006



- ◆ 90% of human West Nile Virus infections occurred outside vector control district boundaries.
- ◆ 100% of equine cases occurred outside vector control boundaries.

# Blood Systems Research Institute Dr. Phillip Norris

- ◆ Collaboration with VRDL to find WNV patients for inclusion in their study on immune system function of WNV patients

# Investigation of the Natural History of WNV Infection in Patients With Recently Acquired WN Fever or Neuroinvasive Disease

- ◆ Multi-Center Clinical Outcome Investigation
- ◆ U.C. Davis School of Medicine
- ◆ Yolo County Health Department aiding in patient recruitment.

# Sacramento County Serosurvey

- ◆ Convenience sample of 145 sera from Sacramento County residents collected in 2005. Purpose to assess general population exposure to WNV during epidemic year.
- ◆ Tested for WNV exposure
- ◆ Further testing on IgG positive samples ongoing

# Conclusion

- ◆ West Nile virus outbreak in California in last three years has provided opportunity to investigate important epidemiological and clinical aspects of WNV infection.